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Procedia Environmental Sciences 10 (2011) 1712 – 1718

Procedia Environmental Sciences

2011 3rd International Conference on Environmental Science and Information Application Technology (ESIAT 2011)

Design and Implementation of Beijing Hanshiqiao Wetland Information System

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Abstract

In order to improve informatization level of wetland management, according to current situation and features of Hanshiqiao wetland in Beijing, Beijing Hanshiqiao wetland information system was built based on ArcGIS,SQLServer2000,VBA,VB6.0,Fragstats and 3S(GIS, RS, GPS). Structure and content of this system were introduced from its structure, data organization and functional design after Hanshiqiao wetland ecological resources were surveyed. Key technology researches were elaborated including desktop wetland information system, network wetland information system and system help construction. It is very great significant for ecological restoration and reconstruction, wetland protection, rational development and utilization of Hanshiqiao wetland, and also provides a reference for other wetlands.

Selection and/or peer-review under responsibility of Conference ESIAT2011 Organization Committee.

Keywords: ArcGIS；Hanshiqiao wetland；information system；landscape indicators

Introduction

Wetland, forest and marine were three global ecosystem types, and wetland was one of the most biological diversity ecological landscapes in nature and the most important living environments of human beings. It had stable environment, species gene protection and resource utilization functions, and was known as the natural kidney, biological gene bank and cradle of mankind[1], and particularly played an irreplaceable role in climate regulation, flood homogenization, purification water, maintaining species genetic diversity, etc. With human's further understanding of wetland importance, wetland ecosystem study by modern information technology, especially the 3S (GIS, RS, GPS) technology, had become the focus and difficulty in relevant study at home and abroad. Its main application [2, 3, 4, 5, 6, 7, 8] concentrated on wetland resources survey, wetland dynamic monitoring, wetland landscape changes

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doi:10.1016/j.proenv.2011.09.269

analysis, wetland mapping, wetland and environmental factors quantitative models, wetland resource management and information system construction, etc.

Hanshiqiao wetland was located in the junction of Yang town and Lisui town in Shunyi district of Beijing municipality. It was the only extant large reed swamp native wetland in Beijing, and known as "Small Baiyangdian" in Beijing suburban. Inland wetland ecosystem type and habitats of many rare birds were great significant for enhancing soil and water conservation in Chaobai river, biological diversity conservation and regional climate regulation. At present, large area of wetland exploitation, successive years of drought and without stable water supply have resulted in water area sharp reduction, vegetation coverage rate reduction, groundwater regulatory and supplemental function weakness in surrounding areas, and biodiversity decreasing in Hanshiqiao wetland. At the same time, traditional information management methods can not meet the development needs because of wetland characteristics including wetland surface features diversity, attributes time-sensitive, massive spatial information, etc. As a result, Hanshiqiao wetland ecological resources were timely and accurately surveyed and basic information databases of wetland reserve district were established, and Beijing Hanshiqiao wetland information system [9] was developed on this basis. It was very great significant for ecological restoration and reconstruction, wetland protection, rational development and utilization of Hanshiqiao wetland, and also provided a reference for accurately grasping and researching current situation and dynamics of wetland resources, wetlands rational development, utilization and protection in other wetlands.

Hanshiqiao wetland ecological resources survey

Hanshiqiao wetland had rich flora and fauna, with the concentrated expression of highly abundant species of aquatic plants and animals and birds [10]. Plant species[11] had 69 families, 191 genera, 292 species, and mainly represented by the reed marsh-type vegetation communities, including marsh plants, shallow water plants and accompanying plants, submerged plants and hygrophyte plants, etc. Animal species had 5 orders, 8 families, 12 species of land mammals such as Lepus Capensis, Hedgehogs, etc, and 4 orders, 6 families, 10 species of reptiles including Eremias Argus, Natrix Tigrina Lateralis and amphibians and reptiles, and 5 orders, 10 families, 19 species of fish, and 12 orders, 61 families, hundreds species of insects. Birds had 14 orders, 46 families, 153 species, including 7 orders, 15 families, 64 species water birds which accounted for 23.62% of China 271 species water birds, while 53.78% of total species of water birds in Beijing. Among these wild birds, there were 2 species (Black Stork, Golden Eagle) which belong to the first class of the national protected birds and 17 species of the second class of the national protected birds.

System structure and content

Structure

Beijing Hanshiqiao wetland information system was designed by the SQLServer2000 as the basis data storage platform, mainly for the storage of spatial data and attribute data. System's three tier architecture was composed of data layer, business logic layer and presentation layer (Fig.1). Data layer achieved effective integration, transmission, storage, management of multi-source data including basic underlying data, hydrologic analysis results, landscape classification results and landscape quality evaluation data; Business logic layer achieved wetland resources and spatial information service integration based on the analysis of wetland management and the building needs, and the formation of system core functional system provided scientific basis for wetland resources management decision-making; Presentation layer achieved the various forms display of business logic analysis results and interaction with the user.

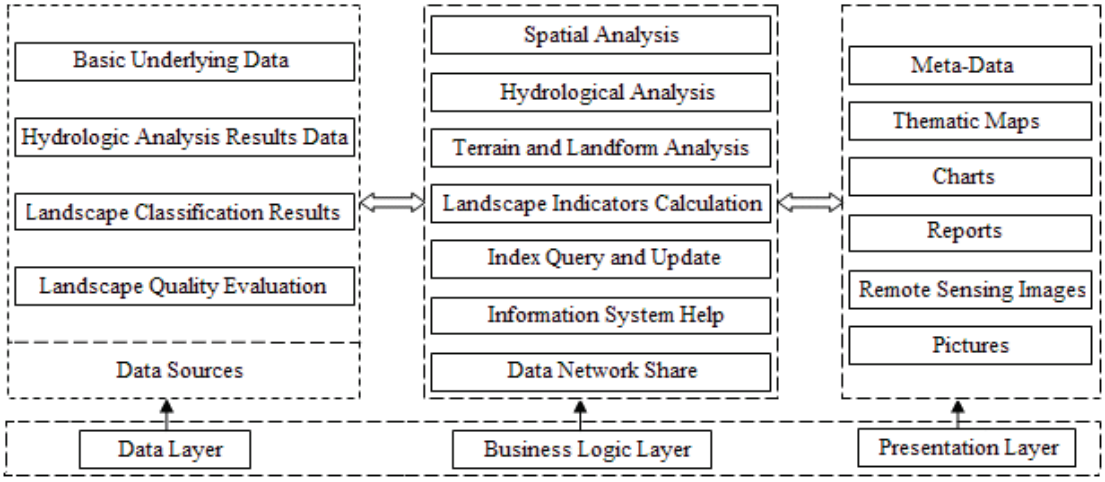

Fig.1 Structure of Beijing Hanshiqiao wetland information system

Data organization

Beijing Hanshiqiao wetland information system was including basic underlying data, hydrologic analysis results data, landscape classification results data and landscape quality evaluation data, etc. Fig.2 was system data organization.

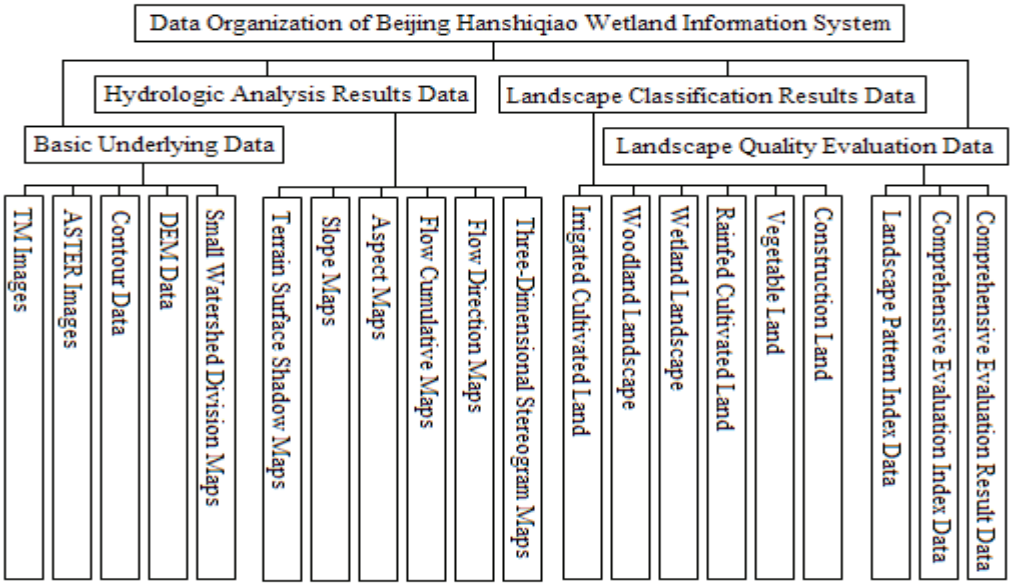

Fig.2 Data organization of Beijing Hanshiqiao wetland information system

Functional design

Fig.3 was Beijing Hanshiqiao wetland information system interface after it was developed completely,

and system functional design consisted of basic editing, spatial analysis, hydrological analysis, index query and update, landscape indicators calculation, information system help and data network share, etc.

Fig.3 Beijing Hanshiqiao wetland information system interface

(1) **Basic editing and spatial analysis**. The user can zoom in, zoom out, pan, add, delete any layer in wetland database and do other basic operations; Related spatial analysis including overlay analysis, buffer analysis, spatial mapping were operated based on the actual needs of wetland research and different target.

(2) **Hydrological analysis**. Hydrologic analysis was used to study the surface physical properties of the surface water. Using DEM data as the main input data, the functions of hydrologic analysis were flow analysis in the study area, extraction of river networks, watershed classification, calculation of flow accumulation, watershed analysis, etc.

(3) **Index query and update**. Users can use the indicators query interface developed by VB 6.0 to set different conditions for different queries of spatial database or property database based on actual business needs. The query results were outputted with the ways of meta-data, thematic maps, charts, reports, etc; Data was stored in database and updated by updating application program interface.

(4) **Landscape indicators calculation**. Landscape indicators calculation soft named Fragstats was integrated and chose to install on the client to achieve a variety of landscape indicators calculations in different periods. Fig.4 was wetland landscape indicators related operations interface.

Fig.4 Beijing Hanshiqiao wetland landscape indicators related operations interface

(5) **Information system help**. Its main function provided help and instructions for user to

comprehensively understand background knowledge in the wetland study area such as geology, geomorphology, hydrological features and biodiversity, etc, and system use methods, maintenance management, etc. At the same time, it also provided customized functions and operating help to upgrade and maintain information system when the system functions were further upgraded and expanded.
(6) **Data network share**. The main function was to allow wetland analysis data permitted to share online, including the underlying data, hydrologic analysis data, landscape classification data, landscape quality evaluation data in the wetland study area, etc. It achieved not only data online related operations, such as the map data of any local zoom in or out, pan, attributes query, any element area calculation, any line length calculation, the coordinates inquiry of any point , Hawkeye operation, navigation, etc; but also basic operations of landscape database including online editing, update, delete, add, etc.

Key technology researches

Beijing Hanshiqiao wetland information system was composed of desktop information system and network information system, and the former mainly achieved spatial analysis, hydrological analysis, landscape indicators calculation and query of wetland basic data while the latter mainly achieved online sharing, query and basic manipulation of part of the spatial data and attribute data, etc.

Wetland desktop information system construction

Desktop information system was customized developed by creating UIControl and writing user needs code in its events based on ArcGIS framework and VBA programming. It combined with landscape indicators query and update applications by VB6.0 construction to provide Fragstats pattern calculation interface. Information systems installation package was integrated with ArcGIS Desktop8.3 and the finished package, Fragstats3.3 by SetUp Factory software, and it was convenient to be installed and run on the server side to achieve system interface integration with the calculation and update of landscape pattern indicators, and related GIS functions. Fig.5 was Beijing Hanshiqiao wetland desktop information system interface.

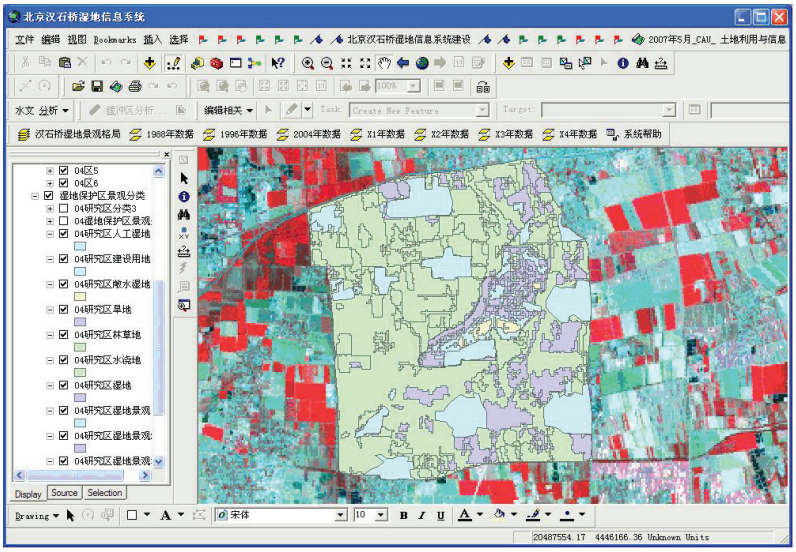

Fig.5 Beijing Hanshiqiao wetland desktop information system interface

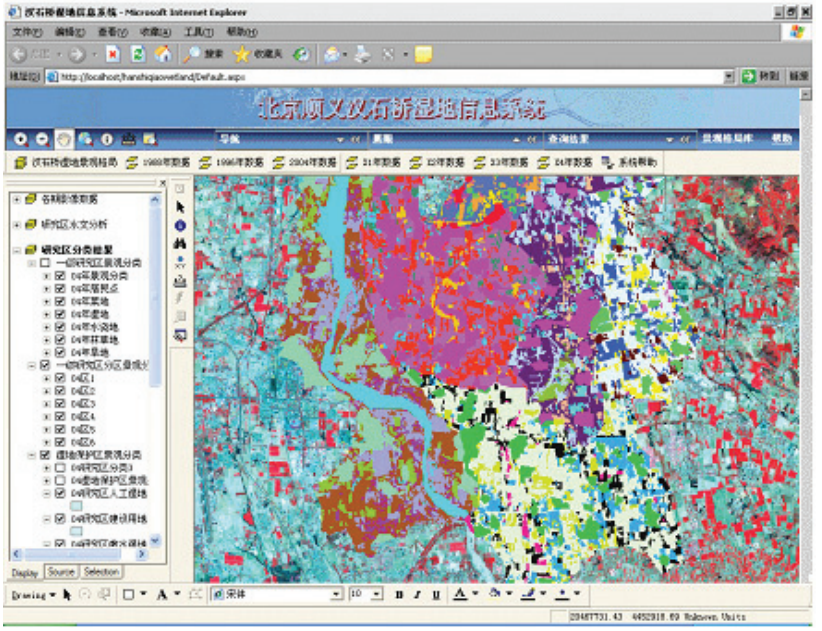

Fig.6 Beijing Hanshiqiao wetland network information system interface

Wetland network information system construction

In order to meet the demand for wetland information data sharing, Hanshiqiao wetland network information system was developed based on .net ADF and ArcGIS Server 9.2 application platform to achieve wetland data network share. ArcGIS Server was a powerful GIS server product for building centrally managed, supporting multiple users, and providing enterprise-class GIS applications and services with advanced GIS functions. It provided a powerful development environment supporting for the .net and a set of customizable programming controls and components. System achieved the map view, pan and zoom, map tips and feature access, spatial query and selection tools, ArcSDE geodatabase editing functions by web map application framework, etc. Maps published, Globe and spatial processing tasks were created by ArcGIS desktop products and published on the ArcGIS Server to create web services. User can access and use these resources by a variety of clients or other servers. Fig.6 was Beijing Hanshiqiao wetland network information system interface.

System help construction

In order to get the system better popularization and application, information system help was produced by Quick CHM software. It was called by the click event programming of UIControl with different formats including .txt, .exe, .hlp, .html, .pdf and .chm, etc. This information system help provided users instructions of complete and detailed system installation, server configuration and system-related operations.

Conclusions

(1) Beijing Hanshiqiao wetland information system based on ArcGIS secondary development achieved

systematic management of wetland data by organically integrating the wetland resources with spatial information technology. It had data of spatial analysis, hydrological analysis, landscape indicators calculation, index query and update, network sharing, etc. And it provided sufficient analysis tool for management departments of Hanshiqiao wetland to make rapid and scientific management and decision-making.

(2) The system has been initially used in the relevant Hanshiqiao wetland management and researches now. Data organization management and functional design will be further expanded and improved, and system will be continuously upgraded to enhance its comprehensive analysis and decision-making ability in the future.

(3) There were also some disadvantages in construction and operation of Beijing Hanshiqiao wetland information system, such as incomplete data in the database, and functional design was relatively simple. But the system's building programs had a certain significance and reference value for other wetland information system construction.

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